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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
Division of Forest Insect Investigations

CONTROL OF THE MOUNTAIN PINE BEETLE WITH TOXIC SPRAYS ON THE MIAMI CREEK AND LEWIS CREEK DRAINAGES MARIPOSA AND MADERA COUNTIES, CALIFORNIA

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By

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INTRODUCTION

The suppressive measures described in this report were put into effect against an epidemic of the mountain pine beetle, Dendroctonus monticolae Hopk., in young second-growth sugar pine during the spring months of 1952 in the Miami Creek and Lewis Creek drainages (Madera and Mariposa Counties) of the Sierra National Forest, California. Steep, timbered slopes, and ridges lying at elevations between 4500 and 6000 feet characterized the project area. The stand (Figure 15), composed of sugar pine, ponderosa pine, white fir and incense cedar, contains an unusually heavy concentration of sugar pine. Killing was confined for the most part to 50-year-old sugar pine, averaging 8 to 10 inches, diameter breast height (graph, Figure 2), which had become established following heavy logging early in the century.

Because of the excellent quality of sugar pine lumber it is anticipated that this species will continue to command a high selling price in the future. Thus, the maintenance of a high proportion of sugar pine in the stand is deemed to be a very desirable goal of forest management. Sizeable expenditures have already been made to protect these second-growth stands from the ravages of fire and white pine blister rust. In recognition of the high values involved and the efforts already expended in the protection of these growing stands, control operations were undertaken at the formal recommendation of the California Forest Pest Control Action Council 1/.

Stand Conditions

In spite of current heavy competition between trees in the many dense sugar pine thickets, growth until now has been good. However, observations indicate that the stand is entering into a critical period in its course toward maturity, and continued satisfactory growth will be accomplished reduction in the number of trees per acre. Reduction in density is a normal occurrence in forests as they struggle to maturity but, if left unregulated by management, it is generally accomplished by the ruthless methods of group killing by forces such as bark beetles which, in alleviating the pressure of many trees, over-correct the condition locally. The results are gaping holes supporting less valuable species or other groups currently not over-stocked, but which will in time grow together and take their turn at being thinned in like manner.

A more appropriate method of relieving the problem is being sought by those familiar with the behavior of the mountain pine beetle and forest management principles. As a first step, control measures have been applied

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1/ Official advisor to the California State Board of Forestry - hereafter referred to as the Action Council.

to reduce the level of loss to a tolerable figure and gain the necessary time to work out through research some silvicultural method which will remove the factors favoring a buildup of the beetles. The experimental work has been initiated by the parties concerned, as proposed by the Action Council, and the results are expected to be applicable in any similar second-growth stand in the westside-Sierra subregion. With the cutting of the last of the State's old-growth pine, insects in second-growth are expected to attain new importance, and it is hoped that a solution will be worked out in advance of probable heavy tree killing.

THE OUTBREAK

First signs of the impending outbreak were encountered in the fall of 1949 by George R. Struble of the United States Bureau of Entomology and Plant Quarantine. His inspections, continuing through 1950, showed no signs of a tendency toward an aggressive outbreak other than scattered groups of young trees.

Although known to have caused repeated killing of young ponderosa pine in Modoc County, there is no record of the mountain pine beetle having caused heavy killing of second-growth sugar pine. Because of the beetle's presumed preference for overmature trees, no great alarm was experienced at the sight of the scattered killing of second-growth in the Miami Creek drainage. However, continued surveillance of the area by Messrs. Struble, and Byron S. Wall, Jr., forester for Yosemite Mountain Ranch, disclosed great activity by the beetles during the spring of 1951. This tempo extended through the ensuing generation of beetles, and before long it became evident that, if total killing of the dense sugar pine was to be prevented, direct action during the following winter would be required. Winter control was selected because the beetles would then be dormant in the cambium region of the main stems, and detection of their presence might be facilitated by some degree of foliage discoloration.

Preparatory to presenting the facts about this infestation before the Action Council for their recommendation, an appraisal survey was conducted. The data concerning the estimated number of trees requiring treatment and the area involved were obtained jointly by men from the Bureau, State Division of Forestry, and U. S. Forest Service, and formed the basis for estimating subsequent control needs. Early participation by all agencies provided an immediate awareness of the seriousness of the loss and the responsibilities of each in the control program. Enthusiastic support for the work was extended by everyone throughout the project and greatly enhanced its successful outcome.

PLANNING AND PREPARATION FOR CONTROL

Meetings and Agreements

Confronted with the facts concerning the infestation, the Action Council appointed a committee to study the problem. Serving on the committee were

Messrs. Willis C. Branch, U. S. Forest Service; Thomas H. Harris, Office of Blister Rust Control; F. Paul Keen, Berkeley Forest Insect Laboratory; Dean F. Schlobohm, California Division of Forestry; and Myron S. Wall, Jr., representing the Yosemite Mountain Ranch interests. The committee's recommendations, subsequently adopted by the Council were as follows:

1. Insect control on the area be initiated in accordance with the recommendations of the Bureau of Entomology and Plant Quarantine.

2. The possibilities of salvage be explored.

3. A Zone of Infestation be declared including the Miami Creek drainage basin, upper Lewis Creek basin and Big Creek basin.

4. Advantage be taken of the Federal Forest Pest Control Act so that private, State, and Federal funds can be pooled for efficient use on the intermingled lands.

In regard to research, the committee further recommended that:

1. There be prompt and aggressive action in planning and setting up a research program aimed at solving the insect problem in second-growth stands.

2. The committee bring together interested agencies to devise a suggested program of research.

Positive action has since followed on each of the Committee's recommendations with the exception of salvage. The very small size of the infested materials precluded its use for sawlogs. However, the experimental work now being done indicates that a pulp thinning of the living trees may prove sufficiently attractive to result in its sale.

On November 27, 1951, the State Board of Forestry declared the Miami Creek Zone of Infestation, enabling State funds to be used in cooperative control work engaged in on private lands within the described zone. There followed a period during the winter when the elements prevented any active work in the field. It was during this time that discussions were carried on between the State Division of Forestry and the U. S. Forest Service in an effort to prepare an agreement by which costs incurred by the State on private land would be paid at the rate of 25 percent private, 50 percent State, and 25 percent Federal funds. In addition, costs incurred by the government on private lands would be reimbursable at the rate of 75 percent of the costs of control, but could not exceed $3000. Agreement to this effect was completed on March 14, 1952. This constituted the first use of Federal Forest Pest Control funds on private land in California, although the Forest Pest Control Act of 1947 authorized their use for such purposes where adjacent values are threatened by the spread of the infestation.

Experimental Work

With the descent of near-record snowfall on the project area, no active field work was possible until March 3, 1952, when experimental spraying was begun by the Forest Insect Laboratory (Figures 6,7,8,9). On the basis of results obtained by Arthur L. Moore in Southern California, it was decided to test under field conditions three different insecticides to determine their effectiveness in killing the beetles. Methods of treatment and average percents of brood mortality were as follows:

AVERAGE PERCENT OF BROOD MORTALITY
FOLLOWING APPLICATION OF TOXIC SPRAY

Insecticide	Method of Application		
	Standing Trees	Fell, Spray Upper Side	Fell, Spray Upper & lower sides by rolling
Diesel Oil	30	31	68
E.D.B. 2/	82	90	97
Ortho 3/	42	78	75
Untreated Check Samples:	25 percent natural mortality		

2/ Ethylene dibromide 1 part, diesel oil 40 parts, by volume.
3/ Orthodichlorobenzene 1 part, diesel oil 6 parts, by volume.

From this test it was concluded that there was a clearcut difference between the insecticides in favor of ethylene dibromide. Furthermore, it was decided that the additional killing brought about by rolling the logs and treating all sides was very desirable.

By way of explanation, the generally better results received by turning the logs is attributed to the effect of bark fissures in preventing the liquid toxicant from flowing to the underside, and the effect of gravity causing excessive runoff of that which did reach the underside. Also, the insecticide did not run downward between sapwood and bark in many cases because of the "green" condition of the late-attacked trees or because bark texture prevented adequate absorption of enough liquid to do so.

Apart from the lower mortality achieved, all consideration of spraying standing trees was dropped because the height of infestation in many trees exceeded the maximum of 25 to 30 feet to which the spray would reach. The following table of infested lengths as measured by G. R. Struble shows their occurrence in a sample of sprayed trees.

HEIGHT OF INFESTATION IN A SAMPLE OF SPRAYED TREES

Infested length (feet)	Number of Trees	Percent of Total Trees
10	0	0
15	5	6
20	5	6
25	12	15
30	9	11
35	15	18
40	9	11
45	5	6
50	8	10
55	2	2
60	7	9
Over 60	5	6
TOTAL	82	100

Spotting Infested Trees

Spotting, or locating, infested trees was begun in the Forest Service area on March 17, 1951, under the direction of Malcolm M. Furniss of the Forest Insect Laboratory. Three crews, each composed of a compassman and two spotters, were usually engaged in this work until late in the project, when final spotting was accomplished by one crew. The accuracy of spotting was greatly enhanced by the use of large scale maps provided by the Office of Blister Rust Control. Because of the great depth of snow which prevented accurate pacing, the compassmen found the maps of inestimable value in plotting tree locations.

The tremendous job of locating every infested tree, made extremely difficult by the heavy snowfall (Figures 4,5), was made even more difficult by the healthy appearance of the foliage, which remained green on the majority of the infested trees during the control work. Because of the concentration of tree killing and the normal appearance of attacked trees, the spotters had to restrict their strips to one chain in width in order to adequately search out each tree for the boring dust clinging to the bark crevices. This was disappointing inasmuch as it reduced the expected width of strips from 5 chains to 1 chain per spotter, thereby cutting progress to a fraction of that originally planned. Consequently, it was unusual for a crew to cover much more than one mile of strip (16 acres) per day.

Scouting

Tending to offset the reduced output of spotting was the discovery that most of the green, but infested, trees were associated with faded trees which had previously been abandoned. For this reason it was found advantageous to scout the control unit to outline the exact areas requiring spotting. Scouting was done by George L. Downing, who classified the unit according to the following categories:

1. [illegible] type. No spotting required.

2. Sugar pine type, no infestation. No spotting required.

3. Sugar pine type, infested. Spotting required.

The use of scouts in work of this sort is heartily recommended, since much area was subsequently placed within the first two of these classes and valuable crew time would otherwise have been consumed in unnecessarily covering uninfested area.

During the course of scouting it became evident that delineation of area for spotting would have been speeded by vertical aerial photo coverage of the entire project area. Further control programs of this sort should include the use of large scale photographic coverage made during a snow-free period in November, when summer-killed trees have thoroughly faded. By establishing the degree of correlation on the ground which exists between the unfaded, infested trees, and the faded, abandoned trees, the scout would then be in a position to make a rapid and accurate delineation of all the area to be spotted.

Equipment

No large scale spray control work had been done in California previously, and the control forces found themselves greatly lacking in the necessary equipment to do the job. Fortunately, Region [illegible] of the Forest Service, made available 35 stirrup pumps (Figures 12, 13, [illegible]) which had been developed in combatting the spruce beetle, Dendroctonus [illegible] Hopk., in Colorado. Costs of the Miami Creek project were lessened a great deal by their use. Also, the Division of Forestry was fortunate in securing the use of a truck equipped for spraying purposes (Figure 11) which was loaned by the Office of Blister Rust Control. The truck carried a 400-gallon tank and 25-horsepower Bean pump which delivered 150 pounds per square-inch nozzle pressure. When fully equipped, this type of truck carries 1000 feet of 1 1/2-inch main hose and 2000 feet of 1/4-inch lateral hose, which is equipped with automatic Hansen joints to enable the breaking of the line while under pressure and addition of 100-foot lateral hose links. As many as three crews can operate from one main line by the addition of the lateral links.

Materials

Ethylene dibromide was obtained in concentrated form under the trad name "Bromofume 85" from the W. R. Grace Company in San Francisco. The chemical was supplied in 28-gallon drums containing 83 percent ethylene dibromide and 17 percent inert materials. Fuel oil was purchased locally.

PROJECT ORGANIZATION AND OPERATION

Agencies Involved

A number of Governmental and private agencies participated in the control work because of the inclusion of National Forest land and several private

holdings within the project area. The organization of the control forces is shown in the chart, Figure 1, on the next page. The technical aspects of the work were handled by the Bureau of Entomology and Plant Quarantine. The spotting and spraying was done by the U. S. Forest Service in Area A (Map, figure 3) and the California Division of Forestry in Area B. The major private owner was the Yosemite Mountain Ranch. Several lesser holdings occurred within the control unit, but work was necessary only on land owned by H. Wolfe and the Oakland Girl Scouts.

Headquarters, Camps

Facilities did not permit housing State and Federal spotting crews together. Also, as a matter of policy, the respective treating crews composed of youths from the California Youth Authority and inmates from the State penal institute at Soledad were quartered in separate camps. Therefore, there were four camps involved; each agency having separate sites for both spotting crews and treating crews.

U. S. Forest Service The Forest Service spotting personnel and foremen of spraying crews were located at Westfall Ranger Station. A cook was employed and provision made for the repair and maintenance of snowshoes and equipment. Mixing tanks and two Forest Service pumper trucks also were located here. Radio contact established with the Forest Supervisor's office in Northfork facilitated the flow of information concerning the project including changes in plans, procurement of supplies, and addition of crewmen as required.

Twenty-five inmates were housed by the Forest Service at a trailer camp located off the highway at the south edge of the project area. Forest Service control operations were administered locally by District Ranger, J. H. Michels, and Assistant Ranger, J. Clyde Werly.

California Division of Forestry Six foremen, functioning as spotters, were stationed at the Ahwahnee Fire Control Station, sixteen miles from Westfall Ranger Station. Travel time to the job was not excessive and the location provided excellent facilities for the men.

Treating of infested trees with the oil spray was done by labor from the California Youth Authority Camp at Coarsegold. This permanent camp, twenty miles from Westfall Ranger Station, eliminated what otherwise would have been a very costly job of constructing a camp capable of handling the 16-man crew.

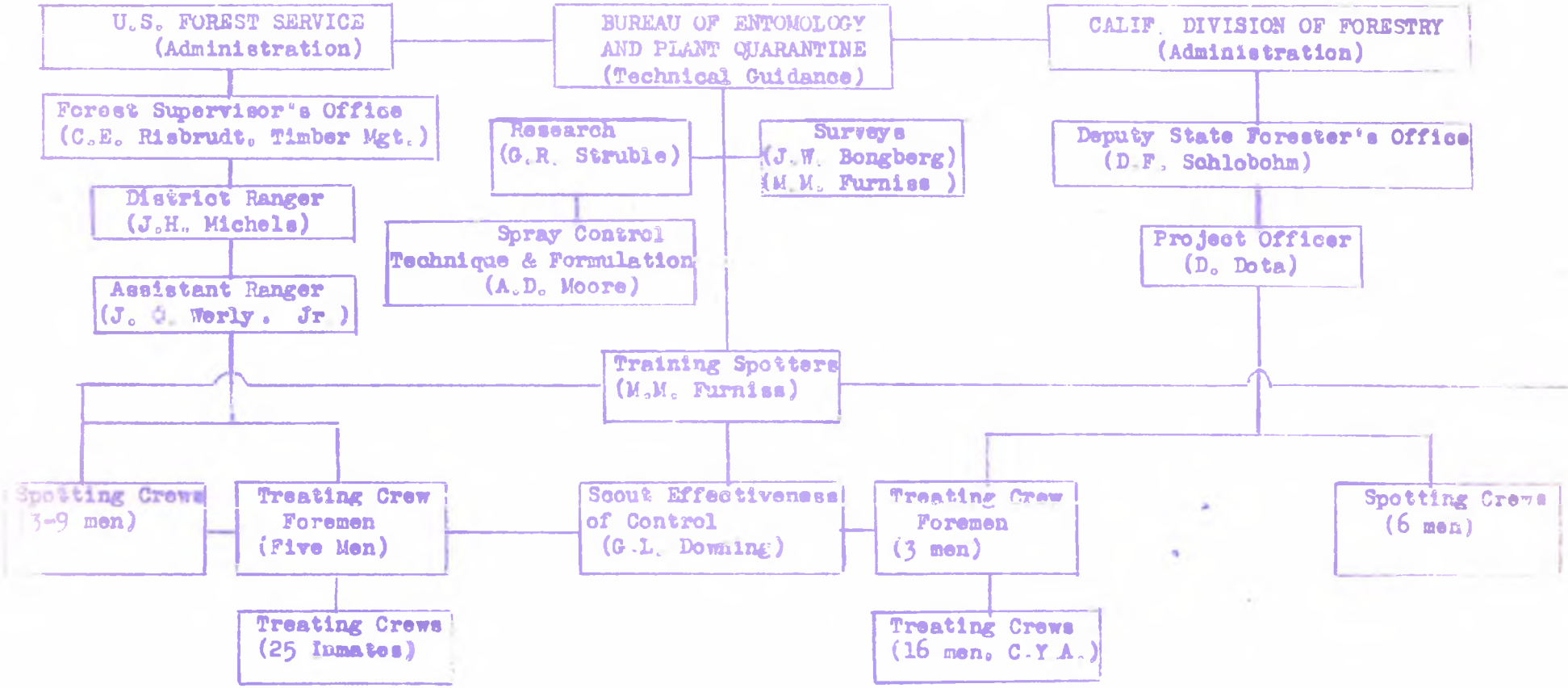
Over-all direction of the work done by the Division of Forestry was provided by Forest Technician Dean F. Schlobohm, and Dan Dotta.

CONTROL OPERATIONS

Technical Supervision

The Berkeley Forest Insect Laboratory provided technical supervision of all entomological phases of the project in order to insure the adequacy of

FIGURE 1. ORGANIZATIONAL CHART, MIAMI CREEK INSECT CONTROL PROJECT, 1951



spotting and spraying as well as to time the work in order to complete it before emergence of the over-wintering broods in the spring. In addition, the Bureau provided for analyses of the insecticide to determine if it met with contract specifications. Jack W. Bongberg was in charge of all technical phases of the Bureau's work.

Spray crews were given instruction in the use of equipment and application of spray by Arthur D. Moore, who gave personal demonstrations to the foremen and crews before work began. The effectiveness of spraying was checked by George L. Downing, who took mortality measurements following application of spray.

Crew Makeup

Initially, the inmates working in the U. S. Forest Service area were formed into 5-man crews, each with a foreman in charge. However, as work progressed, both State and Forest Service crews were used flexibly on various operations, depending on circumstances. Sometimes, for instance, practically every man was busy felling trees in order to keep everyone working and to build up a supply of trees for spraying. In general, when the stirrup pumps were used (Figures 7, 14b), individual crews were composed of the nozzle operator, the pump operator, and three men who kept the spray crew supplied with cans of toxic oil. When spraying was done with hose layed from the pumper truck directly to the tree (Figure 14a), only one man was employed to operate the nozzle while the others strung the hose to each succeeding group of trees, or limbed, bucked, and rolled trees for spraying.

Preparation and Transportation of Insecticide

The insecticide was mixed in outdoor tanks located at the Westfall and Conreegold camps (Figure 10). The mixing operation required thorough but not excessive agitation, since the liquid ethylene dibromide mixes readily with diesel oil.

The only precaution needed was to perform the addition of the toxicant in open air and thoroughly wash the skin if contact was made with the liquid. (No special clothing or masks were required). Following mixing, transportation to the job was effected either by use of 400-gallon capacity pumper trucks or, in the case of the State, by a 450-gallon capacity trailer. Each full tank of insecticide was sufficient to treat approximately 100 trees.

Area and Number of Trees Treated

Approximately 2000 acres were included within the actual area requiring treatment. A total of 2050 trees were sprayed; 871 of these were treated by Division of Forestry crews, while the Forest Service sprayed the remaining 1179 trees.

Although the actual volume of spray applied in each case was proportional to the amount of bark surface to be covered, an average of three to four

gallons per tree was used. This average is consistent with that recommended following the experimental spray work, and indicates that good control over the treating crews was maintained throughout the project.

RESULTS

Mortality and Method of Evaluation

The evaluation of the effectiveness of spraying was determined from samples obtained from selected trees at weekly intervals following treatment. Samples containing one square foot of bark surface were removed from the top, sides and bottom of the trees, and mortality determined for each stage of insect development. The insects' color, condition and response to stimuli were the criteria used in determining whether insects were living or dead. Samples secured fourteen days after treatment from seven selected trees yielded 85 percent over-all mortality. Further observations made on twelve trees on June 9 - 11 revealed no living insects present in them. Final results of the control work will be evaluated late this fall when the attacks by the surviving broods can be detected.

Project Costs

The cost involved in completing this work reflects somewhat the character of the infestation and the difficulties presented by deep snow during much of the project. Total costs as paid by the various individuals and agencies are as follows:

Private	1. Oakland Girl Scouts . . .	$325.00
	2. Howard Wolfe	200.00
	3. Yosemite Mountain Ranch .	2333.96
State Pest Control Funds		5781.57
Federal Pest Control Funds		21,130.86
	TOTAL	$29,771.39

The average cost of treating each of the 2050 trees was $14.52. The somewhat higher cost figures for work performed by the Forest Service are attributable to the need for establishing an inmate camp, an expense that was spared the State by a C.Y.A. Camp already in the area. Also, in starting their spotting later, the State encountered improved weather and snow conditions.

Other factors bearing upon the cost of control were:

1. Weather. The heavy winter impeded operations, necessitated large expenditures for road clearance, snowshoes, etc.

2. Timing of Work. Fall spotting would have provided a complete picture of work to be done and enabled

close figuring of control requirements as well as allowing a later start in spraying. Lack of signed agreements between private, State and Federal agencies was responsible for delay in spotting.

It should not be forgotten that costs would have been much greater had not pumper trucks and stirrup pumps been available on a rental and loan basis. The value of the equipment used was roughly equal to the cost of the project. Also, the occurrence of infested trees in groups made their treatment much more efficient than would have been the case had they been scattered.

RECOMMENDATIONS

In view of the lack of information about this infestation, which required experimental development of an effective control method, the absence of fading, and the adverse field conditions, the Bureau feels that an excellent job was rendered by the entire control force. However, in conducting the project, experience has indicated ways in which subsequent control work of this sort could be improved. Therefore, it is proposed that:

1. Fall spotting would relieve the pressure of many operations otherwise in process during a short period in the spring. This arrangement would provide a buffer in the event that more time was required than was anticipated. Fall spotting was not done on the Miami Creek project due to lack of agreements providing for payment of work performed; therefore.

2. Signed agreements between all agencies and individuals should be secured immediately following the recommendation for control by the California Forest Pest Control Action Council and after a Zone of Infestation has been declared. If any barriers exist which prevent the State or Federal Government from entering into prompt agreements of this sort, effort should be made to eliminate them. Lacking agreements,

3. Assessments or some other provision should be made to insure control when an owner refuses to enter into agreements though his timber is infested and may contribute toward reinfesting the controlled area.

4. Contract labor should be investigated as a means of increasing the efficiency and lowering the cost of treatment. The continued success obtained by the Office of Blister Rust Control in contracting for Ribes eradication leads the Berkeley Forest Insect Laboratory to believe that it is now time to apply this practice in insect control work. Observations lead to the conclusion that the calibre of work performed by the average inmate or C.Y.A. crew would be greatly exceeded by contract labor and with less supervision. Undoubtedly, a start toward contracting the treating phase of insect control should begin on a small and easier project in order to develop trained contractors. In time, perhaps even the spotting phase could be contracted, if trained candidates are developed.

5. Equipment of the types used on the project is excellent for spray control work. The use of stirrup pumps and the pumper trucks will greatly benefit similar projects. The maximum amount of main and lateral hose should be employed on the pumper trucks in order to keep the entire spray crew in action as much of the time as possible. The length of hose carried by the pumper trucks for Ribes eradication can be supplemented for insect control purposes to obtain at least 1000 feet of main hose and 2000 feet of lateral hose.

6. Aerial photo coverage of future projects of this sort is recommended. Scouting would have been facilitated by vertical photos since it was found that the unfaded, brood-laden trees were centered about the faded, abandoned trees. Also, since there was a general correlation between density and occurrence of attacks, the vertical view provided by the photos would have been helpful in locating possible infestations. A permanent record of stand conditions at this point in their development would thereby be recorded and would be of great value in subsequent research on the management of second-growth sugar pine. Past centers of loss could be readily located long after the dead trees had rotted completely and the changes in stand complex resulting from beetle killing could be noted and evaluated.

7. Research, which has begun in the Miami Creek area to determine factors causing the outbreak and ways of preventing similar outbreaks, should be continued with adequate provision for its completion and with the realization that it may require a considerable number of years before a solution is reached. Since the indirect methods developed through research could easily eliminate the necessity of direct control in the future, it is sound business to invest an amount of time and money in it commensurate with that expended in direct control.

SUMMARY

A unique and previously unrecorded outbreak of the mountain pine beetle in young sugar pine became evident during the summer of 1952 in the Miami Creek drainage on the Sierra National Forest in California. The infested stands are made up of an admixture of pine and fir, but contain an unusually large proportion of sugar pine. Rapid detection of the epidemic followed by an appraisal survey of the extensive killing prompted quick action by the California Forest Pest Control Action Council in recommending that suppressive measures be applied against the over-wintering broods of this insect. Responding to their obligations in the matter of protecting this area of dense, fast-growing sugar pine, the California Division of Forestry and the U. S. Forest Service organized their control forces under the technical guidance of the Bureau of Entomology and Plant Quarantine for an all-out attack aimed at reducing beetle population to a safe level.

The extreme denseness of the young trees prohibited the use of fell-peel-burn treatment as a means of destroying the beetles. Instead, toxic-oil spraying was chosen as the control method since the bark on most trees was very thin, permitting thorough penetration of the insecticide. Full-scale control operations were preceded by experimental spraying by the

Bureau of Entomology and Plant Quarantine to test the effectiveness of diesel oil, orthodiclorobenzene and ethylene dibromide against the insect. A solution composed of one part ethylene dibromide in forty parts diesel oil (by volume) was subsequently used, since it resulted in an average brood mortality of 97 percent when applied to all sides of felled trees. Spraying of standing trees was unsatisfactory because it was not possible to reach the top of infestations with the spray, and because where the spray did reach lower mortality was obtained.

Hampered by near-record snowfall as operations got under way, the control forces accomplished their work under extremely adverse field conditions. The foliage of most infested trees remained green throughout the project, requiring that each sugar pine be closely inspected for evidence of frass in the bark crevices which signified the presence of beetles.

The combined efforts of all agencies resulted in effectively destroying the broods in 2050 trees. Of these, 871 were sprayed by the California Division of Forestry and 1179 by the U. S. Forest Service at a total cost of approximately $30,000.

Samples taken from trees following treatment yielded an average mortality of 85 percent two weeks after application of insecticide. Additional checking, six weeks after treatment, revealed no surviving broods in any of the sprayed material examined.

FREQUENCY OF OCCURRENCE OF LOSS BY DIAMETER CLASS
U.S.F.S. AREA, MIAMI CRK PROJECT
SPRING-1952

BASIS: 1153 TREES.

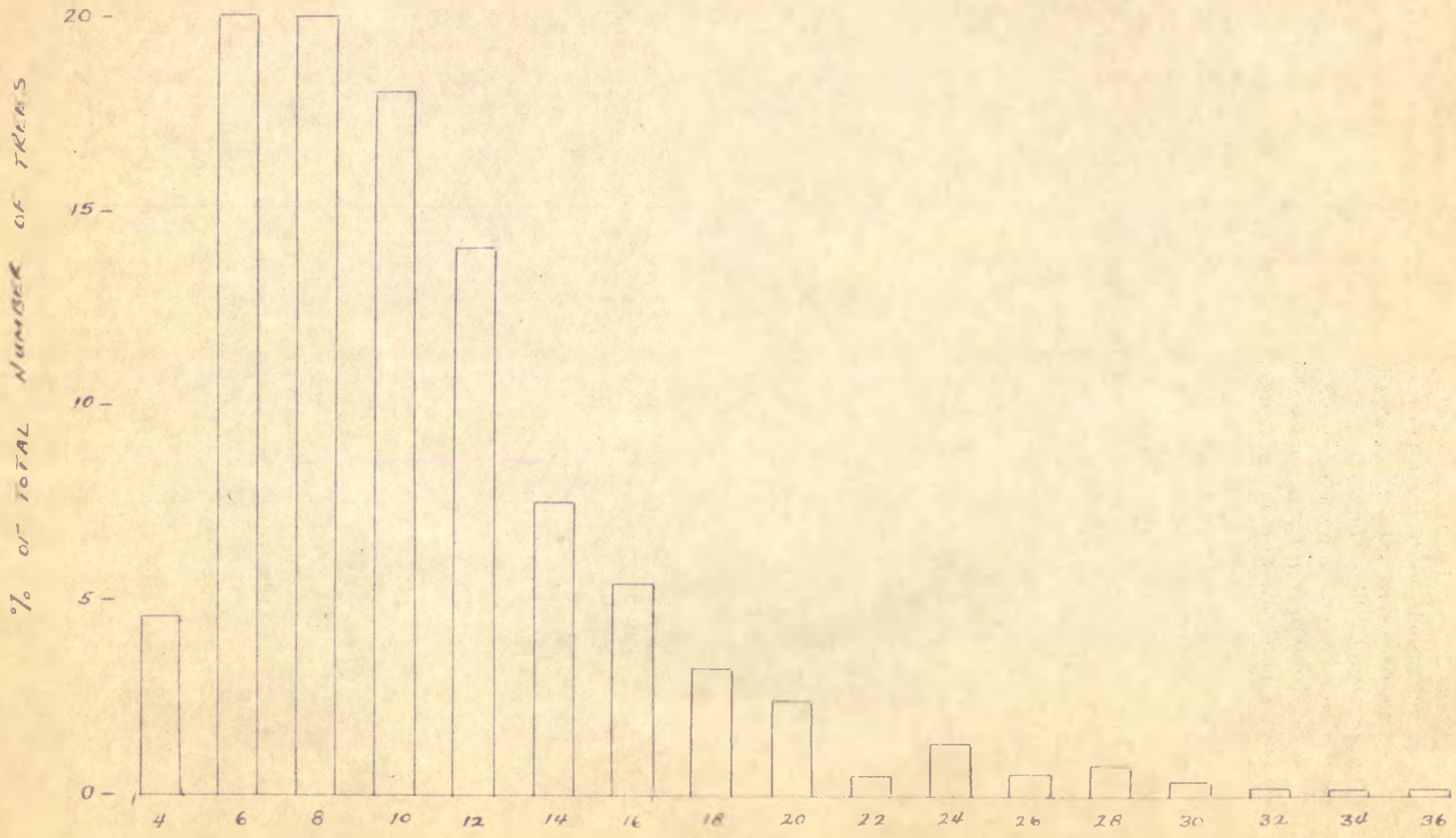
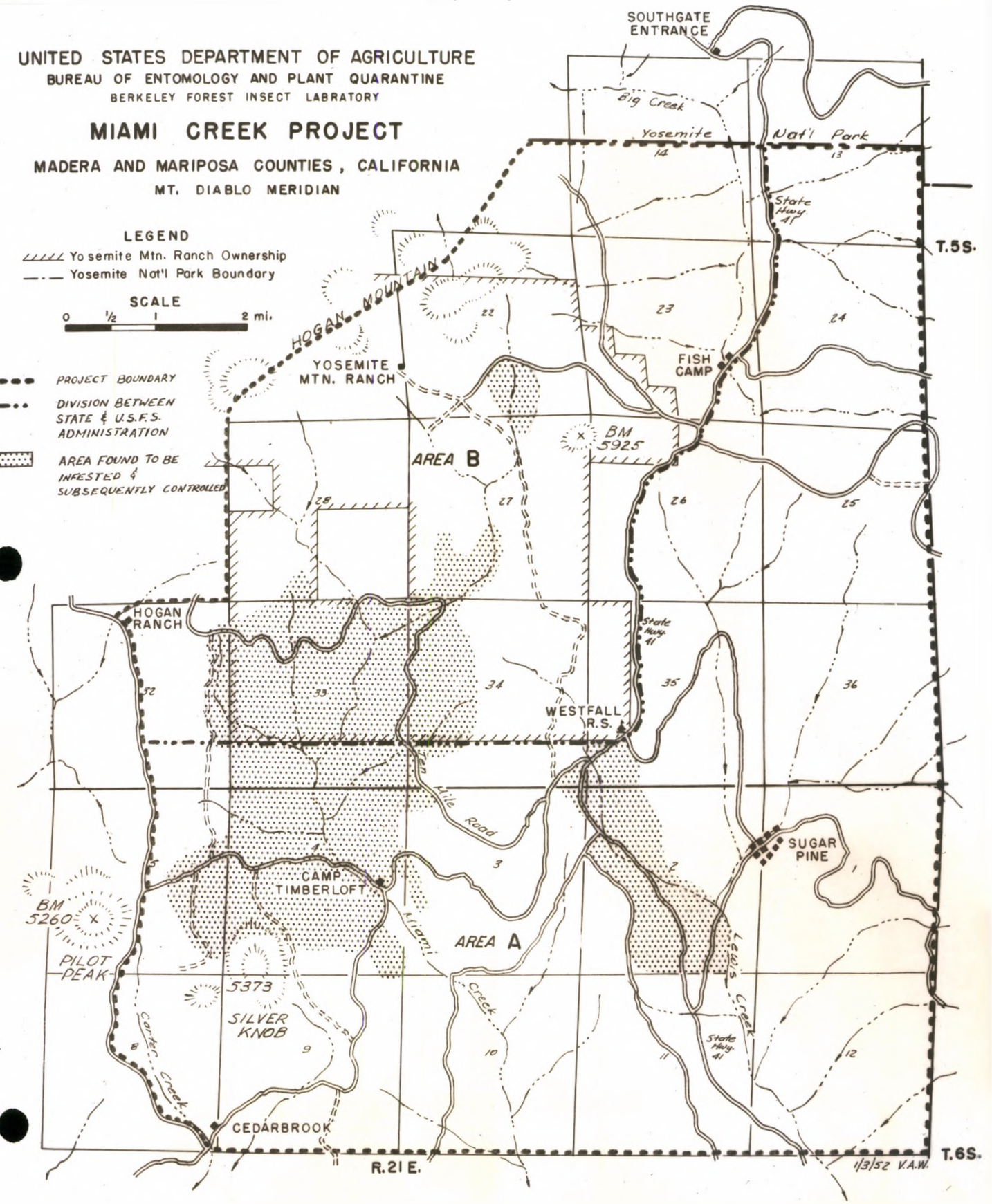


Figure 2

Figure 3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BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE
BERKELEY FOREST INSECT LABRATORY
MIAMI CREEK PROJECT
MADERA AND MARIPOSA COUNTIES, CALIFORNIA
MT. DIABLO MERIDIAN
LEGEND
Yosemite Mtn. Ranch Ownership
Yosemite Nat'l Park Boundary
SCALE
0 1/2 1 2 mi.
PROJECT BOUNDARY
DIVISION BETWEEN STATE & U.S.F.S. ADMINISTRATION
AREA FOUND TO BE INFESTED & SUBSEQUENTLY CONTROLLED
SOUTHGATE ENTRANCE
Big Creek
Yosemite Nat'l Park
State Hwy 41
T.5S.
HOGAN MOUNTAIN
YOSEMITE MTN. RANCH
FISH CAMP
BM 5925
AREA B
HOGAN RANCH
WESTFALL R.S.
Wile Road
SUGAR PINE
CAMP TIMBERLOFT
BM 5260
PILOT PEAK
5373
SILVER KNOB
Miami Creek
AREA A
Lewis Creek
Carter Creek
CEDARBROOK
R.21E.
T.6S.
1/3/52 V.A.W.

Figure 4. Spotting, which could be delayed no longer, had just begun when this photograph of the Miami Forest Insect Laboratory office was taken on March 19. The deep snow necessitated expensive road clearance and had a tremendous effect upon the cost and progress of work.

Figure 5. Secondary roads like the one to the right of the truck had to be cleared and drained before vehicles could be used to transport spotting crews. Until then, spotters snowshoed 6 miles a day to and from the location of their cruise strips. Heavy snow, dislodged from above by the frequent chopping, added to the spotters' discomfort.

Figure 6. Control operations were preceded by experimental spraying to determine the proper toxicant, formulation, and method of application. This tree, felled during tests on March 4, 1952, was one of many with foliage still green and brood in the egg stage. An impression of the size and density of the trees affected is given by the stand in the background.

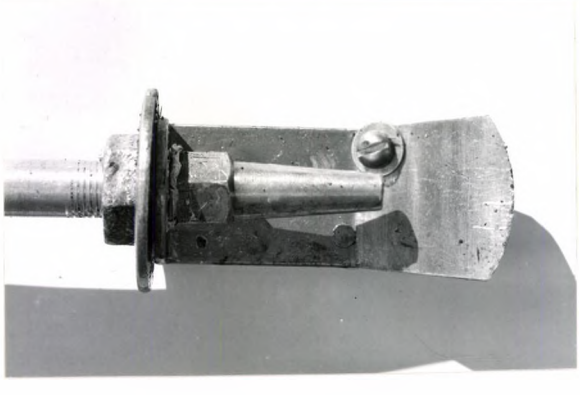
Figure 7. The experimental spraying was done with stirrup pumps using three insecticides: (1) Diesel oil, (2) Orthodichlorobenzene, and (3) Ethylene dibromide. Application was made to standing and felled trees. During subsequent control operation, the trees were felled and ethylene dibromide used since this combination gave 97 percent mortality in the tests.

Figures 8 and 9. Spraying of standing trees had to be ruled out because the spray could not reach the height to which infestations extended in most trees. Also, considering just the length of stem which the spray had reached, less mortality was obtained than when the trees were felled before spraying. Note how trees were marked with aluminum paint so spray crews could locate them.

Figure 10. Mixing of insecticide was done either directly in the 400-gallon pumper truck tanks or in these 550-gallon storage tanks at Westfall Ranger Station.

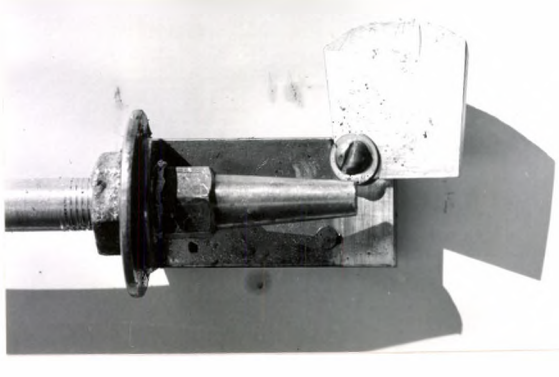
Figure 11. Rear of pumper truck has fittings for 4 main and 4 lateral lines. Convenient couplings facilitate the addition of lateral hose by automatically stopping flow of insecticide when hose is disconnected at joints.

Figure 12. The stirrup pump apparatus shown here was used where hose laying was impractical. Each unit, requiring a 2-man crew to operate, consists of: 5-gallon jeep can, stirrup pump, neoprene hose, hand valve, aluminum tube, machined nozzle, and baffle plate.



Figures 13a and b. Detail of stirrup pump nozzle and baffle plate.

(a) Baffle in place, before nozzle, acts to break up spray for close-in work.



(b) Baffle pushed to one side gives stream for distance spraying.

Figure 14a

Figure 14b

Figures 14a and b. Illustrations of the two types of spray nozzles used to apply insecticide to infested trees. Either equipment worked well as long as a shower-type spray was obtained.

(a) Spray-gun of the type attached to hose from pumper trucks.

(b) Stirrup pump unit.

Figure 15. Type of stand in which control work was conducted. The clearing in the foreground is the boundary of a control unit while the stand in the background indicates the density of the second-growth sugar pine. Over 100 trees were sprayed in the area included in this photograph but are not visible because they remained green until treated.

Figure 16. Thinning of the overcrowded stand by beetles was extremely thorough as evidenced by this clearing. Fourteen trees varying from 4 to 16 inches, d.b.h., were killed in this group leaving only oak and fir.